CLAIMS

1. An information recording medium comprising a recording portion capable of recording information three-dimensionally,

wherein the recording portion comprises at least one particle-containing layer comprising:

particles that absorb at least a part of light with a predetermined wavelength; are substantially transparent to recording light and reproducing light with wavelengths longer than the predetermined wavelength; and have an absorption rate with respect to the light with the predetermined wavelength being higher than the absorption rate with respect to the recording light and the reproducing light, and

a particle-holding material that is substantially transparent to the recording light and the reproducing light.

2. The information recording medium according to claim 1, wherein the average particle-size of the particles is shorter than the wavelength of the recording light and the wavelength of the reproducing light.

3. The information recording medium according to claim 2, wherein the average particle-size of the particles is shorter than a quarter of the wavelength of the recording light and a quarter of the wavelength of the reproducing light.

4. The information recording medium according to claim 1, wherein the particle-containing layer is a recording layer, and the particle-holding material has an optical constant that changes at a predetermined temperature.

5. The information recording medium according to claim 4, wherein the recording portion comprises a plurality of the recording layers, and the plurality of recording layers are laminated via intermediate layers that are substantially transparent to the recording light and the reproducing light.

6. The information recording medium according to claim 1, wherein the recording portion further comprises a recording layer, and the particle-containing layer is an auxiliary recording layer disposed in contact

with the recording layer.

7. The information recording medium according to claim 6, wherein a plurality of laminated bodies composed of the recording layer and the auxiliary recording layer are provided and between the laminated bodies that are adjacent to each other, an intermediate layer that is substantially transparent to the recording light and the reproducing light is provided.

8. The information recording medium according to claim 1, wherein the particle-containing layer is a recording layer; the particle-holding material has an optical constant that changes at a predetermined temperature; and the whole part of the recording portion is made of the one recording layer.

9. The information recording medium according to claim 1, wherein a protective layer that is substantially transparent to the recording light and the reproducing light is provided at the side of the recording portion on which light is incident

10. The information recording medium according to claim 9, wherein the protective layer is made of the same material as that of the particle-holding material.

11. The information recording medium according to claim 5 or 7, wherein the intermediate layer is made of the same material as that of the particle-holding material.

12. The information recording medium according to claim 1, wherein the difference between the refractive index of the particle-holding material and the refractive index of the particles is 0.5 or less.

13. The information recording medium according to claim 1, wherein the particles comprise inorganic materials.

14. The information recording medium according to claim 1, wherein the particles comprise semiconductor materials.

15. The information recording medium according to claim 14, wherein the

semiconductor material has an energy gap of 2.5 eV or more and 8.3 eV or less.

16. The information recording medium according to claim 15, wherein the particles comprise at least one selected from the group consisting of zinc oxide, tin oxide, zinc sulfide, titanium oxide, tungsten oxide, strontium titanate, silicon carbide, indium oxide, and cadmium sulfide.

17. The information recording medium according to claim 5 or 7, wherein the particle-containing layer comprises 1 wt.% or more and 95 wt.% or less of the particles.

18. The information recording medium according to claim 8, wherein the particle-containing layer comprises 0.3 wt.% or more and 10 wt.% or less of the particles.

19. The information recording medium according to claim 1, wherein the particle-holding material is a resin.

20. A method for producing the information recording medium described in claim 1, the method comprising:

forming a coating containing particles and a particle-holding material; and

applying the coating so as to form a particle-containing layer.

21. The method for producing the information recording medium according to claim 20, further comprising: forming an intermediate layer by applying the coating containing materials substantially transparent to recording light and reproducing light,

wherein in the step of forming the particle-containing layer, a material having an optical constant that changes at a predetermined temperature is used as the particle-holding material, and

the step of forming the particle-containing layer and the step of forming the intermediate layer are repeated alternately predetermined number of times.

22. The method for producing the information recording medium

according to claim 20, further comprising: forming an intermediate layer by applying a coating containing a material that is substantially transparent to the recording light and the reproducing light; and forming a recording layer by applying a coating containing a material having an optical constant that changes at a predetermined temperature;

wherein the step of forming the particle-containing layer, the step of forming the recording layer, and the step of forming the intermediate layer are repeated in a predetermined order and predetermined number of times periodically.

23. An optical information recording/reproducing apparatus for recording and reproducing information with respect to the information recording medium described in claim 1, the apparatus comprising:

a light source for emitting recording light;

a light source for emitting reproducing light;

an objective lens for focusing the light emitted from the light sources on the information recording medium; and

a photodetector for detecting light reflected by the information recording medium;

wherein by using the change in the optical constant of a recording portion of the information recording medium, an information bit is recorded on the recording portion three-dimensionally.

24. The optical information recording/reproducing apparatus according to claim 23, wherein the light source for emitting recording light is a pulse laser light source, and a pulse width is in the range from 100 femtoseconds to 10 nanoseconds.

25. The optical information recording/reproducing apparatus according to claim 24, wherein the pulse width is in the range from 1 picosecond to 100 picoseconds.

26. The optical information recording/reproducing apparatus according to claim 23, wherein the wavelength of the light source for emitting reproducing light is shorter than the wavelength of the light source for emitting recording light.

27. The optical information recording/reproducing apparatus according to claim 23, wherein the information bit is recorded on the recording portion of the information recording medium by using a nonlinear absorption phenomenon.

28. The optical information recording/reproducing apparatus according to claim 27, wherein the nonlinear absorption phenomenon comprises the two-photon absorption or multiphoton absorption.

29. The optical information recording/reproducing apparatus according to claim 23, wherein the information bit is recorded three-dimensionally on the recording portion of the information recording medium in an order in which the recording light does not pass through information bits that already have been recorded on the recording portion.

30. The optical information recording/reproducing apparatus according to claim 29, wherein the information bit is recorded sequentially in the order from the position distant from the objective lens to the position near the objective lens in the recording portion of the information recording medium.

31. The optical information recording/reproducing apparatus according to claim 23, wherein one light source is shared for the light source for emitting the recording light and the light source for emitting the reproducing light.